'Prosper': A High-Yielding Hard Red Spring Wheat Cultivar Adapted to the North Central Plains of the USA

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ABSTRACT

Providing wheat (*Triticum aestivum* L.) growers and industry with adapted wheat cultivars with high-quality attributes is essential for maintaining wheat as a competitive crop in the spring-wheat growing region of the USA. Therefore, our breeding program aims to develop modern wheat cultivars using both traditional and modern breeding tools. 'Prosper' (Reg. No. CV-1080, PI 662387) hard red spring wheat was developed at North Dakota State University and released jointly by the North Dakota Agricultural Experiment Station and the Minnesota Agricultural Experiment Station because of its good adaptation to the spring-wheat-growing regions in the U.S. North Central Plains. However, the high yield potential of Prosper under high rainfall conditions makes it more adapted mainly to wheat-growing regions in eastern North Dakota, western Minnesota, and high-rainfall regions of neighboring states. It has high yield potential and good milling and baking properties. Gene postulation shows that Prosper has the *Lr21* gene, which confers resistance to leaf rust (caused by *Puccinia triticina* Eriks.). However, 2011 field observations show that Prosper is susceptible to a new race that overcomes the *Lr21* gene. Prosper is resistant to stem rust (caused by *Puccinia graminis* Per.:Pers. f. sp. *tritici* Eriks. & E. Henn) and moderately resistant to Fusarium head blight (FHB), or scab [caused by *Fusarium graminearum* Schwabe; telomorph *Gibberella zeae* (Schwein.) Petch].

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Abbreviations: AYT, advanced yield trial ; EYT, elite yield trial; FHB, Fusarium head blight; HRSW, hard red spring wheat; HRSW-VT, HRSW variety trial; IYT, intermediate yield trial; NDAES, North Dakota Agricultural Experiment Station; NDSU, North Dakota State University; RCBD, randomized complete block design; SNB, Stagonospora nodorum blotch; STB, Septoria tritici blotch; URN, Uniform Regional Nursery.

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'Prosper' (Reg. no. CV-1080, PI 662387) hard red spring wheat (HRSW; *Triticum aestivum* L.) was tested as experimental line ND808, which was developed by the HRSW breeding program at North Dakota State University (NDSU) and jointly released by the North Dakota Agricultural Experiment Station (NDAES) and the Minnesota Agricultural Experiment Station. In addition to researchers at NDSU, USDA-ARS researchers at Fargo, ND contributed by testing Prosper for resistance to stem rust (caused by *Puccinia graminis* Per.:Pers. f. sp. *tritici* Eriks. & E. Henn). Prosper combines very high yield potential with good end-use quality and medium resistance to both Fusarium head blight [FHB; caused by *Fusarium graminearum* Schwab; teleomorph *Gibberella zeae* (Schwein.) Petch] and leaf diseases. Prosper was named after the small town of Prosper, which is located in Cass County, ND, where the NDSU HRSW breeding program conducts its main breeding activities.

Prosper, a sister line of 'Faller' (PI 648350; Mergoum et al., 2008) was derived from the ND2857/'Dapps' (PI 633862, Mergoum et al., 2005a) cross made at NDSU in fall 1997. ND2857 (ND2709/ND688) is a hard red spring experimental line with good resistance to FHB originating from ND2709, a line known to possess the *Fhb1* quantitative trait locus derived from 'Sumai 3' (PI 481542). Sumai3 is a spring wheat from China that is arguably the most widely used source of resistance to FHB in the world. Both ND2709 and ND688 are HRSW experimental lines developed by the

NDSU breeding program. Prosper was produced from a bulk of one purified $F_{7:8}$ plot selected in 2001 at Christchurch, New Zealand.

Methods

Early-Generation Development

Prosper was developed using a combination of pedigree and modified-bulk breeding methods. The F_1 seeds from the cross leading to the development of Prosper were grown in the NDSU greenhouse at Fargo, ND in spring 1998, and the F_2 population was grown in the field at Prosper during the summer of 1998. One hundred spikes were selected from the F_2 population, harvested, threshed individually, and advanced to obtain F_3 seed in the greenhouse during the winter of 1998–1999. Subsequently, spikes were selected from each selected F_3 row, threshed individually, and sown in $F_{3:4}$ headrow plots at Prosper in summer 1999. Ten spikes were selected from the best row, harvested, threshed in bulk, and advanced as F_5 headrow plots at Prosper in 2000. Subsequently five spikes were selected from the F_5 rows, threshed individually, and sent to a New Zealand off-season nursery and planted as $F_{5:6}$ rows during the winter of 2000–2001. Selected rows from New Zealand were harvested in bulk and planted in an F_7 intermediate yield trial (IYT) in two locations during 2001. Selections in the segregating generations (F_2, F_3, F_4, and F_5) were based on reactions to FHB or scab [caused by *F. graminearum* Schwabe; telomorph *Gibberella zeae* (Schwein.)] and leaf diseases, particularly leaf rust (caused by *Puccinia triticina* Eriks.), and stem rust (caused by *Puccinia graminis* Per.:Pers. f. sp. *tritici* Eriks. & E. Henn) and on agronomic merits including plant vigor, height, and earliness. In New Zealand, selection was based mainly on visual uniformity, lack of grain shattering, plant height, and lodging resistance.

Line Selection and Evaluation

Prosper was evaluated for agronomic and quality traits in the IYT in 2001 and 2002, the advanced yield trial (AYT) in 2003, and the elite yield trial (EYT) in 2004. Subsequently, Prosper was tested in the North Dakota HRSW Variety Trials (HRSW-VTs) from 2005 to 2010 (Table 1). Prosper was also tested in the spring wheat Uniform Regional Nursery (URN) in 2009 and 2010 (Table 2). All yield trials were arranged in a randomized complete block design (RCBD) with two replicates for the IYT and four replicates for the AYT and EYT. The plot size consisted of seven rows that were 3 m long and 30 cm apart. While the IYT and AYTs were grown at four North Dakota locations (Casselton, Minot, Carrington, and Prosper), and the EYTs were grown at three additional North Dakota locations: Hettinger, Langdon, and Williston. The HRSW-VT is a state-wide trial conducted at seven locations across North Dakota in an RCBD with four replicates. The experimental unit consisted of eight rows that were 10 m long and 30 cm apart. The URN trials were conducted during 2009 and 2010 in 28 location-years across the states of North Dakota, Minnesota, South Dakota, Nebraska, Montana, Wyoming, and Washington, and in Manitoba, Canada. These trials were laid out in an RCBD with three replicates. Depending on the location, the experimental unit consisted of six to eight rows that were 3 m long and 30 cm apart.

Prosper was tested under greenhouse or growth-chamber conditions for its reaction to different races of tan spot [caused by *Pyrenophora tritici-repentis* (Died.) Drechs], Septoria tritici blotch [STB; caused by *Mycosphaerella graminicola* (Fückl) J. Schröt. in Cohn], Stagonospora nodorum blotch [SNB; caused by *Stagonospora nodorum* (Berk.) Castellani & E.G. Germano], leaf rust, and stem rust. It was also evaluated for FHB reaction in greenhouse and field tests from 2004 to 2010. The SNB, STB, and tan spot diseases are major components of the leaf spotting complex of wheat in North America. A complex of these diseases occurs in nature. Hence managing leaf spot diseases is difficult; however, resistant cultivars are the most effective and economical means of controlling leaf spot.

Tan spot disease can cause two phenotypically distinct and independent symptoms in wheat: tan necrosis and extensive chlorosis (Lamari and Bernier, 1989). Until recently, eight races of tan spot had been identified (Lamari et al., 2003). Prosper was tested for resistance to three races of tan spot in growth chamber and greenhouse experiments. These three races (2, 3, and 5) in combinations form the virulence for all the known eight races for wheat. The experiments were arranged as an RCBD with three replicates and three plants per replicate as the experimental unit. For disease evaluation, the lesion-type scale developed by Lamari and Bernier (1989) was used in which 1 = resistant with small, dark brown to black spots without any surrounding chlorosis or tan necrosis, and 5 = susceptible with dark brown or black centers that may or may not be distinguishable and have most lesions were coalescing with each other.

Prosper was also tested for its reaction to SNB based on a lesion-type scale developed by Feng et al. (2004) in which 1 = pinpoint dark brown lesions without chlorosis; 2 = small lesions with very little necrosis or chlorosis; 3 = chlorotic or necrotic lesions completely surrounded by a chlorotic ring; 4 = lesions completely surrounded by chlorotic zones, some of the lesions coalescing; and 5 = extensive chlorosis and large necrotic lesions. Ratings of 1–2 were considered resistant while those with 3–5 were classified as susceptible. The evaluation of Prosper for STB was based on a scale developed by McCartney et al. (2002) in which 0 = immune, 1 = highly resistant, 2 = resistant, 3 = moderately susceptible, 4 = susceptible, and 5 = highly susceptible. Ratings of 0–2 were considered resistant while those with 3–5 were considered susceptible. The reaction of Prosper for SNB and STB was based on greenhouse experiments arranged in an RCBD with three replicates, and three plants per replicate as the experimental unit.

The evaluation of the resistance of Prosper to FHB was conducted from 2006 to 2010 in 16 FHB nurseries under both field (12 location-years) and greenhouse (four experiments) conditions. The FHB field nursery was laid out in an RCBD with four replicates and inoculated with the FHB pathogen using the spray inoculation method described by Rudd et al. (2001) with overhead mist irrigation

Table 1. Summary of agronomic data for Prosper and check cultivars tested in the North Dakota Hard Red Spring Wheat Variety Trials, 2005 to 2010.

Cultivar	Grain yield			Grain protein	1000-kernel weight	Grain volume weight	Heading date	Height	Straw strength
	North Dakota	Eastern North Dakota	Western North Dakota						
	kg ha^{-1}			%	g	kg m^{-3}	d after 1 June	cm	0–9†
Prosper	4415	5389	3897	14.2	33.5	763	61.6	83	1.5
Barlow	4232	4938	3857	14.8	31.6	782	58.4	85	1.5
Faller	4409	5310	3930	14.1	32.9	758	61.3	83	1.6
Glenn	4003	4630	3671	15.0	31.5	802	57.9	87	1.3
Howard	4214	5026	3783	14.5	31.7	778	59.7	85	2.0
Steele-ND	4110	4804	3742	14.8	32.2	777	59.5	85	2.2
Dapps	3852	4472	3340	16.1	29.7	756	58.2	91	1.9
Alsen	3799	4325	3577	15.2	30.5	774	59.8	81	1.3
Parshall	3633	4443	3143	15.2	27.3	774	59.4	90	1.1
Reeder	3867	4485	3671	14.9	30.9	768	60.9	81	0.8
LSD (0.05)	209	157	260	1.1	3.1	22	1.7	3.3	.9
No. of environments	63	22	41	61	29	63	98	63	35

†0 = completely erect; 9 = completely flat at harvest.

Table 2. Summary of agronomic data for Prosper and check cultivars tested in the Hard Red Spring Wheat Uniform Regional Nursery, 2009 and 2010.

Cultivar	Grain yield	Grain volume weight	Grain protein	Heading	Height	Straw strength
	kg ha^{-1}	kg m^{-3}	%	d after 1 June	cm	0–9†
Prosper	4773	770	14.3	30.5	87	1.0
Verde	4287	765	14.0	28.2	83	0.7
2375	4178	771	14.0	26.9	85	2.2
Keene	3985	776	14.3	27.5	98	2.1
Chris	3104	753	15.0	29.5	102	5.1
Marquis	3048	758	14.4	30.3	104	3.9
LSD (0.05)	432	11	0.8	1.1	3.3	1.0
No. of environments	28	28	28	28	28	28

†0 = completely erect; 9 = completely flat at harvest.

to enhance disease development. Each entry was assigned to a hill plot consisting of 8 to 10 plants. Similarly, the greenhouse experiments were arranged in an RCBD with three replicates. The entries were assigned to a 0.25-m-row plot. Evaluation for FHB reaction was done on 10 random spikes from each plot and were scored for FHB disease severity (Stack et al., 1997).

Prosper's reactions to the prevalent races of leaf and stem rusts was done on the basis of 8 field tests (RCBD, four replicates, and 1-m row-plot per replicate) and 10 greenhouse tests (RCBD, three replicates, and four plants per replicate) from 2006 to 2010. Prosper was specifically evaluated in the greenhouse for its reaction to the leaf rust pathotypes MCDL and THBJ. Additional stem rust testing included naturally inoculated field nurseries at two North Dakota locations (Langdon and Carrington) and an artificially inoculated field nursery in Fargo, ND using *P. graminis* f. sp. *tritici* races TPMK, TMLK, RTQQ, QFCQ, and QTHJ. Prosper was evaluated in these three field nurseries from 2006 to 2010. Prosper was also evaluated in the greenhouse from 2006 to 2010 with individual inoculations of the same races used in the Fargo field inoculation.

Seed Purification and Increase

Prosper was first produced from a bulk of purified F_{11} headrows selected in 2004 at the Prosper, ND nursery. Further purifications of Prosper seed were performed each year by selecting 300 spikes from the quality drill strips grown at Prosper, ND from 2005 to 2008. These spikes were threshed individually and seeded as headrows at Prosper, ND. Nonuniform rows were discarded, and the remaining rows from the 2009 headrow increases were bulked and planted in the 2008–2009 winter nursery grown near Yuma, AZ as the first seed increase of Prosper. Further seed increase of Prosper was continued by the NDSU seed-stock program in the summers of 2009 and 2010. The purity of Prosper was maintained throughout the increase process based on visual elimination of off-type (taller, different spike color, and presence/absence of awns) plants.

Statistical Analysis

Analysis of data was conducted with SAS-JMP version 6.0.3 (SAS Institute Inc.). Grain yield and other agronomic data, such as grain volume weight from the IYT, AYT, and HRSW-VT, were subjected to analysis of variance across locations within years, and a combined analysis across location-years was performed whenever error variances were homogeneous. In these analyses, only entries common to the trials across years were included. A mixed model with genotypes as fixed effects and environments and replications within environments as random effects was used for within-year analyses. Similarly, across-year analyses were also done according to a mixed model with genotypes as fixed effects and environments as random effects. Tukey's HSD test (α = 0.05) was used to compare the least squares means for the genotype effects.

Characteristics

Agronomic and Botanical Description

Prosper is an awned, medium- to late-maturing, semidwarf hard spring wheat. It has a middense head type and plant height (83 cm) that is significantly taller ($P < 0.05$) than that of 'Alsen' (PI 615543; Frohberg et al., 2006) and 'Reeder' (PI 613586) (81 cm) but shorter than that of Dapps (91 cm) and 'Parshall' (PI 613587) (90 cm). Prosper's height was, however, similar to that of 'Faller' (PI 648350; Mergoum et al., 2008) (83 cm), 'Steele-ND' (PI 634981; Mergoum et al., 2005b) (85 cm), and 'Howard' (PI 642367; Mergoum et al., 2006b) (85 cm) (Table 1). In the URN trials, the height of Prosper was 87 cm, which was comparable with that of 'Verde' (PI 592561; Busch et al., 1996) (83 cm) and '2375' (85 cm) but significantly shorter ($P < 0.05$) than that of 'Keene' (PI 598224 PVP) (98 cm), 'Chris' (CItr 13751; Heiner and Johnston, 1967) (102 cm), and 'Marquis' (104 cm) (Table 2). Marquis is an old spring wheat cultivar released in 1911 (Underdahl et al., 2008). The number of days to heading of Prosper (61.6 d) was not significantly different ($P < 0.05$) than for Reeder (60.9 d) and Faller (61.3 d), but it was later than all the other checks including 'Glenn' (PI 639273; Mergoum et al., 2006a) (57.9 d), the earliest check (Table 1). In the URN trials, Prosper did not differ from Chris and Marquis in terms of heading but was later than Verde, Keene, and 2375 (Table 2). Straw strength (lodging) was evaluated on a scale of 0 to 9, where 0 = completely erect, and 9 = totally flat at harvest. Prosper was relatively resistant (1.5) and was similar to all checks except Steele-ND, which had a significantly higher ($P < 0.05$) lodging score (2.2; Table 1). Similarly, the lodging score of Prosper grown in the URN was 1.0, similar only to that of Verde (0.7) but significantly ($P < 0.05$) less than that of the other checks (Table 2).

Prosper is erect in its early stages with a light green plant color at the boot stage. Prosper has medium-erect flag leaves, which may be slightly twisted, and shows a waxy canopy at the boot stage under dry conditions. The heads of Prosper are white, awned, middense, and slightly inclined. The glumes of Prosper are white and medium long with elevated medium-width and medium-length shoulders and acuminate beaks. Prosper's kernels are oval, red, and hard textured with a long noncollared brush, a rounded cheek, a medium-width and medium-depth crease, and a large germ.

Prosper was observed for 12 crop cycles (F_3–F_{14} generations) from 1999 to 2010. It was found to be uniform and stable during the latest generations of seed increase (headrow increases and large drill-strip increases in 2005 to 2010, breeder-seed increase in 2009, and foundation-seed increase in 2010). Prosper remains stable in its essential and distinctive characteristics when sexually reproduced. Variants are limited to (i) taller plants (5–30 cm) that occur at a frequency of less than 5 in 1000 plants and (ii) awnless plants at a trace frequency of less than 1.5 in 10,000 plants. The variants in Prosper are within commercially acceptable limits for all described traits.

Disease Reactions

When artificial inoculation with FHB disease was used to cause intense disease pressure, the average severity (Stack and Frohberg, 2000) recorded for Prosper in the field scab nursery (23%) was significantly lower ($P < 0.05$) than that for the very susceptible check '2398' (70%) (Table 3). In the same trials, the average FHB severity for Alsen was 22%; for Glenn, 25%, and for ND 2710 (PI 633976; Frohberg et al., 2004), 13%. Alsen was released in 2000 as the first NDAES cultivar with resistance to FHB and was widely grown in North Dakota from 2001 to 2006. Glenn was also released by the NDAES in 2005 for its FHB resistance and has been the most widely grown cultivar in ND since 2007. In the greenhouse and under artificial inoculation (data not shown), the average FHB severity of Prosper was 33%, which was similar to the scores of Alsen (28%) and Glenn (30%); and significantly lower ($P < 0.05$) than the 87% and 71% registered for the susceptible checks 2398 and Reeder. Field testing and screening tests of seedlings and adult-plants conducted under greenhouse conditions from 2004 to 2010 showed that Prosper is resistant to the pathotypes of the predominant race of leaf rust in the region. Gene postulation shows that Prosper possesses *Lr21,* which confers resistance to the major races of leaf rust in the spring region. Recently, however, a new race that has overcome *Lr21* was observed in Minnesota and North Dakota (Table 3). Prosper is also resistant to the stem rust races TPMK, TMLK, RTQQ, QFCQ, and QTHJ under field and greenhouse conditions (Table 3). Prosper was screened for tan spot, STB, and SNB under greenhouse conditions. Prosper had an average scores of 2.2, 2.2, and 3.6 for tan spot races 2, 3, and 5, respectively, while Alsen scored 3.5, 1.9, and 2.0 for the same races (Table 3). In the same screening tests, the reactions to the races 2, 3, and 5 of the check 'Salamouni' (PI 182673) were 1.4, 1.4, and 1.3 and of the check 'Glenlea' (CItr 17272) were 4.3, 2.0, and 1.9. Salamouni is considered among the best sources of resistance to tan spot, whereas Glenlea is usually used as the susceptible check to race 2. The scores for the reaction of Prosper to STB and SNB were 2.2 and 2.4, while Alsen had scores of 2.7 and 4.4; Salamouni, 1.7 and 1.7; and Glenlea, 2.4 and 3.7 (Table 3).

Table 3. Disease reactions of Prosper and check cultivars tested in the North Dakota Hard Red Spring Wheat Variety Trials between 2004 and 2010.

Cultivar	FHB† severity	Leaf rust		Stem rust		Tan spot			Septoria tritici blotch	Stagonospora nodorum blotch
		Greenhouse‡	Field	Greenhouse§	Field	Race 2	Race 3	Race 5		
	%					1–5¶				
Prosper	23	R/MR#	R/S#	R-MR#	R–MR#	2.2	2.2	3.6	2.2	2.4
Alsen	22	R	MR/MS	R-MRs	tR	3.5	1.9	2.0	2.7	4.4
Glenn	25	R	R	R-MR	R	—	—	—	—	—
Traverse	—	R	MR/MS	R	R	3.6	3.1	3.2	2.9	2.6
Knudson	—	—	R	R	R	1.6	1.6	1.8	2.2	1.6
Reeder	—	R	S	MR/R	5R	2.5	1.5	3.9	2.9	2.2
Steele-ND	—	R	R	R	R	2.1	2.0	4.0	2.7	4.0
2398	70	R	R	R	R	—	—	—	—	—
2710	13	R	R	R	R	—	—	—	—	—
Baart	—	—	S	—	50S	—	—	—	—	—
Glenlea	—	—	—	—	—	4.3	2.0	1.9	2.4	3.7
Salamouni	—	—	—	—	—	1.4	1.4	1.3	1.7	1.7
No. of environments	11	9	5	4	9	6	6	6	4	4

†FHB, Fusarium head blight; % severity scored on 10 spikes (Stack and Frohberg, 2000).

‡Greenhouse reactions for leaf rust races MCDL and THBJ.

§Greenhouse reactions for *P. graminis* f. sp. *tritici* races TPMK, TMLK, RTQQ, QFCQ, and QTHJ.

¶1 = resistant; 5 = susceptible (Lamari and Bernier, 1989).

#R, resistant; MR, moderately resistant; MS, moderately susceptible; S, susceptible; TR, trace/resistant; 5R, resistant with 5% disease severity; 50MS, moderately susceptible with 50% disease severity.

Grain Yield Performance and Quality Parameters

Grain yield and other agronomic traits were based on as many as 63 location-years of testing in the HRSW-VTs (Table 1). Based on data from these trials, grain yield of Prosper (4415 kg ha^{-1}) was similar to that of 'Barlow' (Mergoum et al., 2011) (4232 kg ha^{-1}), Faller (4409 kg ha^{-1}), Howard (4214 kg ha^{-1}), and Steele-ND (4110 kg ha^{-1}). However, Prosper yielded significantly ($P < 0.05$) more than several previously released NDSU cultivars, including Alsen (3799 kg ha^{-1}), Glenn (4003 kg ha^{-1}), Dapps (3852 kg ha^{-1}), Parshall (3633 kg ha^{-1}), and Reeder (3867 kg ha^{-1}) (Table 1). Yield data shows that Prosper is more adapted to eastern North Dakota (5389 kg ha^{-1}) compared with its yield (3897 kg ha^{-1}) in western North Dakota (Table 1). In the URN trials conducted in 2009 and 2010 (28 location-years), Prosper had a yield of 4773 kg ha^{-1}, which was significantly ($P <$ 0.05) higher than all other cheeks, including Keene (3985 kg ha^{-1}), Verde (4287 kg ha^{-1}), and Chris (3104 kg ha^{-1}) (Table 2). The 1000-kernel weight of Prosper was 33.5 g, compared with 31.6 g for Barlow, 32.9 g for Faller, 31.5 g for Glenn, 31.7 g for Howard, 32.2 g for Steele-ND, 29.7 g for Dapps, 30.5 g for Alsen, 27.3 g for Parshall, and 30.9 g for Reeder (Table 1). Across 63 location-years, mean grain volume weight of Prosper (763 kg m^{-3}) was not significantly different than all checks except Glenn, which had a significantly higher ($P < 0.05$) grain volume weight (802 kg m^{-3}; Table 1). In the URN, the mean grain volume weight of Prosper was 770 kg m^{-3} compared with 765 kg m^{-3} for Verde, 771 kg m^{-3} for 2375, 776 kg m^{-3} for Keene, 753 kg m^{-3} for Chris, and 758 kg m^{-3} for Marquis (Table 2). The grain protein content of Prosper (14.2%$^{-}$) was comparable with that of all checks, except Dapps, which had a significantly higher ($P < 0.05$) grain protein content of 16.1%. Similarly, in the URN trials, Prosper's grain protein was 14.3%, comparable with all checks (Table 2). More critical quality parameters for cultivar release, including falling number, flour extraction, and dough and baking parameters, for Prosper and major HRSW cultivars included in the HRSW-VT grown in North Dakota from 2004 to 2010 are reported in Table 4. The falling number of Prosper (414 s) was not significantly different than that of the most commonly grown HRSW cultivars, including Howard (422 s), Glenn (394 s), Steele-ND (432 s), Alsen (414 s), and Reeder (430 s) (Table 4). Similarly, the flour extraction value (Table 4) of Prosper (709 g kg^{-1}) was similar to that of Howard (696 g kg^{-1}) and Steele-ND (692 g kg^{-1}); however, it was significantly ($P < 0.05$) superior to that of Glenn (680 g kg^{-1}), Alsen (688 g kg^{-1}), and Reeder (684 g kg^{-1}). Mixing peak time of Prosper was 8.2 min, not significantly different from the checks, except Glenn (10 min) and Alsen (10.1 min). The mixing tolerance score (14.5 min) was significantly shorter ($P < 0.05$) than for Glenn (20.4 min) but comparable with the scores of rest of the checks (Table 4). Bread loaf volume produced from Prosper (1000 mL) was comparable with that of all of the checks, except for Glenn (1056 mL) (Table 4). Similarly, the water absorption of Prosper (64.4%) was not significantly different from that of the checks, except for Steele-ND (66.4%) (Table 4).

Availability

Breeder seed of Prosper will be maintained by the Seed Stocks Project, Agricultural Experiment Station, North Dakota State Univ., Fargo ND 58105-5051. Multiplication and dis-

Table 4. Quality parameters for Prosper and check cultivars tested in the North Dakota Hard Red Spring Wheat Variety Trials, 2005 to 2010.

Cultivar	Falling number	Flour extraction	Peak time	Mixing tolerance	Loaf volume	Water absorption
	s	g kg^{-1}	min		mL	%
Prosper	414†	709	8.2	14.5	1000	64.4
Howard	422	696	8.2	15.0	1006	66.1
Glenn	394	680	10.0	20.4	1056	65.3
Steele-ND	432	692	8.1	14.1	1015	66.4
Alsen	414	688	10.1	17.0	1018	65.3
Reeder	430	684	6.9	12.1	979	64.3
LSD (0.05)	28	19	1.7	3.7	22	1.3
No. of environments	35	35	35	35	35	35

†Values within a column followed by the same letter are not significantly different at the $\alpha = 0.05$ probability level according to Tukey's HSD test.

tribution rights of other classes of the certified seed have been transferred from NDSU to the NDSU Research Foundation, 1735 NDSU Research Park Drive, Fargo, ND 58105-5002. Application to protect Prosper recognized classes of Foundation, Registered, and Certified seed under the U.S. Plant Variety Protection Act is pending. Seed of Prosper has been deposited in the National Plant Germplasm System, where it will become available for distribution after expiration of PVP, 20 yr after the date of publication. Small quantities of seed for research purposes may be obtained from the corresponding author for at least 5 yr from the date of this publication. Seed distribution of Prosper for research purposes will be according to the provisions of the Wheat Worker's Code of Ethics (Annual Wheat Newsletter, 1995).

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